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THE BEGINNING OF THE SCHOOL[1]

IT is appropriate, upon this occasion, that reference should be made to the condition of scientific education in this country at the time of the foundation of the institute and that an outline of its early history should be given.

At the beginning of the nineteenth century the study of the physical sciences in the United States was in its infancy. Scarcely any provision was made for scientific instruction in any of the colleges of the country. Astronomy, physics, chemistry and botany had indeed been taught, during the preceding century, in a few institutions of learning, a department of mathematics and natural philosophy having been created in Harvard College as early as 1727, a professorship of botany in Columbia in 1792 and a class of chemistry at Princeton in 1795. Instruction had also been given in physics and chemistry in the University of Pennsylvania and Dartmouth College and in physics in Union College. This short list, however, includes all the colleges which had given the physical sciences more than an insignificant place in their curriculums. Even in these the instruction was given by lectures, supplemented, at times, by experiments which the teachers performed. Anything approaching laboratory work by the student was almost wholly unknown. When Professor Silliman was elected, in 1801, to the chair of chemistry, geology and mineralogy in Yale College, he visited Dr. McLean, who was professor of chemistry at Princeton, and there for the first time saw experiments in chemistry performed. Considering the state of scientific knowledge at this period and the general lack of opportunity for the study of science, even in Europe, it is not remarkable that this should have been the case in a new country, the total population of which, in 1800, was less than that of the city of New York to-day.

With the general awakening to the value of a knowledge of the natural sciences, during the first quarter of the nineteenth century, came provision for their study in other of the academic schools of the country. Within that time courses in various branches were inaugurated at Yale, Williams, Bowdoin, Dickinson, William and Mary and Hobart Colleges, and in the universities of Georgia, North Carolina and South Carolina. Facilities for practical

[1] Address of the president at the centennial celebration of Rensselaer Polytechnic Institute, Friday, October 3, 1924.

work by the students were still wanting in nearly all of them, though the apparatus used for illustration had grown in quantity and variety. A chemical laboratory, already mentioned, was in existence at Princeton, one was fitted up at Williams College in 1812, and one at Harvard shortly after this date. A few others were also to be found. They were all, of course, crude and unpretending, compared with those thickly scattered over our country to-day.

The time had now come, not only for the addition of scientific courses to the curriculums of institutions of learning, but for a general diffusion of scientific knowledge among those who could not have the advantage of an education higher than that offered by the common schools. Attempts in this direction had already been made in Europe. When Count Rumford returned from Munich to London in 1795 he endeavored to interest the people of England, as he had those of Germany, in his plans for public and domestic economy, more particularly in the economic consumption of coal, improvements in the construction of fireplaces and the heating of buildings by steam. Or as he put it in a circular issued in London in 1799, to interest them in the *application of science to the common purposes of life.* His efforts and those of others in this direction resulted in the establishment, in the year 1800, of the Royal Institution of Great Britain. Other men had not been blind to the benefits which would result if the people generally could be instructed in the application of science to the common purposes of life. Franklin's opinions upon this subject are well known. John Adams believed that the state should make provision for this purpose and Jefferson also proposed a school of technical philosophy, to be maintained wholly at public expense, where various artisans could learn as much of the sciences, as then known, as might be necessary to pursue their work understandingly.

The influence of such opinions gave impetus to the diffusion of scientific knowledge among the people of this country, and during the first quarter of the century two schools were established here avowedly for the purpose of giving instruction in the applications of science. The first was incorporated under the name of the Gardiner Lyceum in Gardiner, Maine, in 1822 and opened in 1823 by Benjamin Hale, who afterwards became president of Hobart College. In his inaugural address, delivered January 1, 1823, this young man, who was graduated only four years before from Bowdoin College, referring to the students to be, said:

> It is not sufficient for them, as for the general scholar, to be taught the general laws of chemistry, they must be instructed particularly in the chemistry of agriculture and the arts. It is not sufficient for them to be able to repeat and to demonstrate a few of the general laws of mechanics, they must be taught the application of the laws. They must be made acquainted with machines.

All honor to the young scholar who foresaw the trend of the times, but his school had a short life. The lyceum existed only about ten years and was discontinued on account of the withdrawal of a legislative appropriation.

The second school, the centenary of which we are gathered here, at this time, to celebrate, was founded in 1824 in Troy, New York, by Stephen Van Rensselaer, of Albany, and was called the Rensselaer School, since changed in name to Rensselaer Polytechnic Institute. Thus was inaugurated the first school, having a continuous existence, to be established in any English-speaking country primarily for the teaching of science and engineering.

The founder was a man of position and education. He was the fifth in direct line of descent from Kilian Van Rensselaer, a merchant of Holland who purchased from the Indians, in 1637, a district about twenty-four miles in breadth by forty-eight in length, comprising the territory which has since become the counties of Albany, Columbia and Rensselaer in the state of New York. Stephen, born in 1764, was graduated from Harvard in 1782 and in 1783 took charge of his estates. He became a man of great prominence, experienced in large affairs. He was lieutenant-governor of New York State for six years; a member of the National House of Representatives for three terms; the general in command of the state militia in the war of 1812; a member of two constitutional conventions, of one of which he was president; for twenty-six years a trustee of Williams College; a regent of the University of the State of New York for twenty years and its chancellor during the last four years of his life; a member of the Erie Canal Commission from its creation in 1816, he was its president from 1824 until his death in 1839. As a great landholder he was naturally interested in agriculture, and while in the House of Representatives was chairman of its committee on agriculture. Some years before this time he was elected president of the short-lived Central Board of Agriculture of the state. Although the life of the board was brief, it was long enough to permit a geological and agricultural survey of the counties of Albany and Rensselaer, made under its direction though at the expense of its president. This survey was executed by Professor Amos Eaton and was the first attempt made in this country to collect and arrange geological facts with a direct view to the improvement of agriculture. Analyses of soils were included, as well as a consideration of the proper methods of culture adapted to them, and the results were published in three volumes of transactions. Im-

ned with strong opinions as to the value of such scientific investigations, when the board ceased to exist Stephen Van Rensselaer was unwilling to discontinue work of this character and in the years 1822 and 1823 he caused to be made at his own expense, under the direction of Professor Eaton, a geological survey extending from Boston to Lake Erie, a distance of about five hundred and fifty miles. It embraced a belt fifty miles in width which covered, in this state, the line of the Erie Canal.

The intelligence and benevolence of the founder were now, when he had reached the age of sixty years, to be directed into a new channel. He had long been interested in the instruction of the poorer families of his tenantry and had reached the conclusion that the most valuable education to be given persons engaged in the ordinary occupations of life was one which would enable them to apply the principles of science to the "business of living." His first step in this direction was to engage Professor Eaton to deliver, in various places along the line of the Erie Canal, during the summer of 1824, a series of lectures, accompanied with experiments and illustrations on "chemistry, natural philosophy and natural history." This undertaking was entirely successful. Encouraged by it he determined to establish an institution, the object of which he defined in a letter written from Washington, while he was a congressman, to Rev. Dr. Samuel Blatchford, the school's first president. The letter was dated November 5, 1824. In it he appoints trustees, notifies them that a suitable building has been acquired and funds provided for necessary apparatus, gives rules for the government of the school, and defines his object as follows:

> I have established a school in the north end of Troy, for the purpose of instructing persons who may choose to apply themselves in the *application of science to the common purposes of life. My principal object is to qualify teachers for instructing the sons and daughters of farmers and mechanics,* by lectures or otherwise, in the application of experimental chemistry, philosophy and natural history to agriculture, domestic economy, the arts and manufactures.

His primary object, therefore, was to establish a school of high grade for teachers of science, and in his mind, as his letter shows, the broad field to be covered included *the application of science to nearly every branch of human endeavor.* It will be noticed that the *daughters as well as the sons were to be taught* by these teachers and that domestic economy was one of the subjects in which instruction was to be given.

In his letter the founder appointed Amos Eaton professor of chemistry and experimental philosophy, and lecturer on geology and land surveying. He well knew his man and he appointed no common one to be the first director. Surveyor, chemist, botanist, geologist, author of many works on these subjects, called in after years "the father of American geology," Eaton was above all a born teacher. His reputation was already established. In the catalog of 1826, the first one containing a list of students, of the twenty-five whose names were given, seventeen came from the state of New York and eight from five other states, Vermont, New Hampshire, Massachusetts, Pennsylvania and Ohio. Some of these must have come on foot or on horseback, part of the way at least, to reach Troy. For while there were some canals and some steamboats, there were no railroads and few highways in those days, and it is a great tribute to the reputation of Eaton and of the school, then less than two years old, that students should have come to it so early after its foundation from such distant places. It may be said that since those times students have continued to come from distant places, the records showing that they have come from all the states and territories of the Union and from thirty-eight foreign countries.

While at the beginning the principal object of the founder was to establish a school for the instruction of persons who would disseminate among the people generally information relating to the application of scientific principles to their various occupations, neither the founder nor the management of the institution had in mind the narrowing of its scope or the limiting of its usefulness as a school for teaching the applications of science to the *"business of living."* And so while many of those who had been graduated in the early years afterwards became eminent in various departments of pure and applied science, the renown of the school is principally due to the work of its alumni in the field of engineering—a course in which was soon added to the curriculum.

Some of the principles of certain branches of the science now broadly called civil engineering had been known, of course, since the earliest historical times. Besides various branches of natural science, some of these principles were taught, in this country, in the early founded schools and colleges to which reference already has been made. They were taught, also, in the Military Academy at West Point, which was established in 1802, though it was a school in name only until its reorganization after the war of 1812. On the continent of Europe a number of technical institutions had already been founded, most of which were maintained partly or wholly by the state. The École des Ponts et Chausses was established in France as early as 1747, though it did not become of importance as a school for engineers until a much later period. The Königliche Sächsische Bergakademie was founded in Freiberg in 1765; the École Polytechnic in Paris in

1794; the Polytechnisches Institut in Vienna in 1815, and the Königliches Gewerbe Institut in Berlin in 1821. The latter at the time of its foundation and for twenty-five years thereafter was, as its name indicates, a trade rather than an engineering school. A technical high school was also established in Prague in 1806. The École Centrale des Arts et Manufactures, a private institution, was established in Paris in 1829.

The continental schools of science antedated those of Great Britain. Mention, however, should be made here of Anderson College of the University of Glasgow, founded in 1796 with a bequest of Professor John Anderson, who provided for an institution for the instruction of artisans and others unable to attend the university. In 1799 lectures on mechanics and applied science were begun and these ultimately led to the establishment of mechanics institutes in many towns. But the college never developed into a school of engineering. It was later converted into a medical school. Among the English schools in which scientific instruction was early given may be mentioned University College, established in London in 1828. In the University of London engineering subjects were first taught in 1840. The school of engineering in Dublin University was founded in 1842. Other well-known British schools of science and engineering were established at still later dates.

Although science and some branches of engineering were taught in the early foreign schools, at the time of the foundation of Rensselaer School, there were few engineers, other than military engineers. The term civil in distinction from military engineer had been coined during the last quarter of the eighteenth century, it is believed by Smeaton, but it did not come into general use until the end of the first quarter of the nineteenth century. There had been, of course, inventors and constructors of genius throughout all the ages. Great ruins on more than one continent attest the skill of forgotten engineers. During the Renaissance, Brunelleschi, Michael Angelo and the great Leonardo da Vinci lived and builded and at the later period about which we have been speaking such names as Smeaton and Watt and Fulton come to our minds. But these engineers were born; not made in schools.

There were no schools of engineering in the United States because civil engineering had hardly yet been recognized as a profession. A consideration of the condition of the country and of the state of scientific knowledge as applied to the constructive arts towards the beginning of the nineteenth century shows why this was the case. In comparison with the European states, in which early schools of science above mentioned had been established, the country was new and sparsely settled. Methods of communication were primitive and traveling was expensive. The first canal of considerable length, and these were the first engineering works of great magnitude to be built here, was begun in 1816 and finished in 1825; no steam railroad existed, locomotives not becoming practically successful until about 1830.

Steam navigation was in a more forward state, Fulton's Clermont having made the trip up the Hudson in 1807. In 1815 there were steamboats running between New York and Providence. It was not until 1838 that a transatlantic voyage was made wholly by steam. Steam had however been used for pumping water at a comparatively early date, and there were about seven steam engines in this country at the beginning of the century, although the small amount of power required for manufacturing purposes was obtained from wind and water. During the first quarter of the century many wooden bridges of long span were built, but the era of iron bridges did not begin until 1840. The first tunnel was built in 1831.

The few historical facts above given serve to indicate the condition of engineering science at the period of the school's history we are now considering. Although many of the fundamental principles of applied mechanics were known as well then as now, the development of the science, particularly in its application to structures and machines for the production of useful work, had taken place largely upon empiric lines. Most of the eminent men to whom this development had been due were self taught, were mechanics whose results had been obtained by successive experiments and with little knowledge of the resistance of materials or of the principles of the design of engineering constructions as practiced to-day. And if with these conditions there are taken into consideration the comparative smallness of the population and its extended geographical distribution, the wise forethought and liberality of mind displayed by the authorities of the school in establishing at such an early date a department of civil engineering will be thoroughly appreciated.

An outline of the course of study given in the first catalog, published in 1825, includes land surveying, mensuration, measurements of the velocity of flow of water in rivers and aqueducts, besides mathematics, chemistry, experimental philosophy, astronomy and geology. The catalog of 1826 shows that instruction was given in hydrostatics and hydrodynamics and in calculations upon the application of water power and steam, and in that of 1827 reference is made to land surveying and general engineering. In the catalog of 1828 the duties of Professor Eaton included lectures on civil engineering. This is the first appearance of the term "civil engineering" in any of the catalogs

and no well-defined course in the subject was formulated for several years, though the curriculum of 1831 included elements and applications of civil engineering. In 1835 the trustees created a department "for the purpose of giving instruction in Engineering and Technology" and in the same year the first class in civil engineering was graduated. The course in civil engineering was reorganized in 1849–50 by Director B. Franklin Greene, one of the ablest men ever connected with the faculty. Departments of mechanical and electrical engineering were established in 1907 and that of chemical engineering in 1913.

It will be noticed that this sketch has had reference almost entirely to a few of the early years in the life of the school. Much of interest, even of those days, has had to be omitted. Van Rensselaer's first orders for the government of the institute, the rugged character and original methods of instruction of Amos Eaton, sidelights on the lives of the students, all would be of interest to the historian. Nor have I touched upon the influence of the school upon the development of scientific education and the practice of engineering in this and other countries. These phases of its influence, admittedly great, will be considered to-morrow by Dr. Ray Palmer Baker, distinguished in letters, professor of English in this institution.

PALMER C. RICKETTS

AFTER ONE HUNDRED YEARS[1]

WE are met to celebrate the hundredth anniversary of the foundation of Rensselaer Polytechnic Institute. It is therefore fitting that we should ask ourselves how far the aspirations of its founders have been justified by its fruits.

To-day the first fruits seem remote indeed. As President Ricketts explained yesterday, Stephen Van Rensselaer proposed to establish in Troy a school for the "sons and daughters of farmers and mechanics." Nominally, therefore, the institute was devoted to the education of both sexes. Actually, it existed for men only. Nevertheless, it exerted a profound and lasting influence upon the colleges and universities which opened their doors to women during the nineteenth century. Before its incorporation, Eaton had conducted courses in botany, zoology, physics and chemistry throughout the eastern states; and not a few of the women who had attended these courses followed him to Troy. One, Mary Lyon, who had been a student in Northampton, became the founder of Mount Holyoke College. Others, also, profited directly by the facilities provided by the authorities of the institute. Naturally, however, its greatest services were rendered by its sons who had been moulded in the spirit of the senior professor. One of them, Eben Norton Horsford ('38), believing, like him, that the failure of women to achieve intellectual distinction was due to lack of opportunity and not to the "perversion of female genius," endowed the laboratories of Wellesley College. Others were active in the state universities. In two at least they were largely responsible for the inclusiveness of which they rightly boast; and in many others they upheld that equality of privilege which we now accept as a matter of course. To the education of women, therefore, Rensselaer made no slight contribution.

Not only was it the first institution to provide—though unofficially—for the scientific education of women, but it was also the first to offer a curriculum in agriculture leading to a degree. Of the interesting features of that curriculum, which it maintained for ten years, I can not speak to-day. Suffice it to say that the young men who enjoyed its advantages established the first state department of agriculture, the first state bureau of entomology and one of the first state experimental stations. The influence of the institute was not limited, however, to governmental departments, bureaus and stations; for in the universities of Alabama, California, Iowa and Wisconsin, as well as in a number of smaller institutions, its alumni served as first professors of the sciences in their relation to agriculture. As in its provision of educational facilities for women, Rensselaer was thus a pathfinder in a field which it has long since abandoned.

Somewhat similar has been the history of its influence upon the academic college. Rensselaer was the first institution to offer the degree of bachelor of arts to students who had completed a course of study in the natural, mental and social sciences. The curriculum leading to this degree—a curriculum embracing mathematics, the sciences, public speaking, literature, rhetoric, composition, government, political economy and philosophy—foreshadowed, in many ways, the type toward which instruction has tended in the last two decades. More significant, however, than this fact, striking as it is, is the theory on which it was based. "Things, not words," was Eaton's motto; and this touchstone he applied to every subject which he professed. As a result of his success, he lived to see the experimental methods which he advocated introduced into many of the colleges which had attacked his proposals. Indeed, before his death he was generally recognized as the originator of field work and laboratory practice in the United States. In themselves these two contributions, rich in result and richer in promise, would almost justify the foundation which we are met to commemorate.

There are other reasons, however, for this celebra-

[1] Address at the centennial celebration of Rensselaer Polytechnic Institute, Saturday, October 4, 1924.

tion. Although Eaton was inclined to challenge the value of the disciplines inherited by the colleges which had scouted his efforts, he soon realized that they were destined to play an essential part in the system which he was attempting to develop; and he was not slow to accept their assistance. As early as 1827 the authorities announced that graduates of recognized colleges and of the United States Military Academy could complete the requirements for a degree in half the usual time. Somewhat later Eaton added that the courses at Rensselaer were intended primarily for those who had completed their academic education; and, in 1832, he asserted that it had become *"the common workshop* for all colleges, academies and other literary and scientific seminaries of learning." What he visualized, therefore, was a graduate school with distinct professional standards; and such a school—the first of its kind—existed in this city for nearly three decades. At times almost half of those enrolled were college graduates—alumni of older institutions, like Amherst, Columbia, Dartmouth, Harvard, Pennsylvania, Princeton, Yale, Union and Williams, represented here to-day. In all, the institute drew in this way upon nearly one hundred centers of higher learning in Europe and America. In the variety of its contributions to educational practice it has not been surpassed.

Nevertheless, in all the enterprises which I have mentioned its achievements were restricted by the years apportioned to them. Indeed, it might almost seem as if its history is a history of lost causes and as if its greatest glory has been due to its renunciations. No such supposition is justified; for each of the developments of which I have spoken—by-products, as it were—bore a definite relation to the ideal which actuated its founders. From the beginning Rensselaer had been devoted to the advancement of science and engineering. In science and engineering it has contributed most to the progress of humanity; and it is because of its primacy in science and engineering that we are met to-day. It is therefore proper that we should attempt to evaluate the fruits of its leadership in these two fields.

I have already stressed Eaton's interest in science. In botany and zoology, physics and chemistry, geology and mineralogy, he was a pioneer; and in all these subjects Rensselaer was a pathfinder.

Of its contributions to botany and zoology I have given you at least an inkling. From the institute came the first text-books in the vernacular. From it came many of the earliest reports, especially those on the flora and fauna of the northwest. Moreover, the young men educated here were the first to establish departments and bureaus for the application of botany and zoology to the needs of agriculture. It is interesting, too, to recall that in a dozen institutions they dealt with them in their relation to medicine as well. Nor, in view of those assembled here to-day, ought we to forget that they not only served such colleges as Middlebury, Rutgers and Williams, but that they also introduced these subjects at such universities as Iowa, Michigan and Wisconsin.

Nevertheless, distinguished as is the record of the institute in the biological sciences, it was terminated at an early period by another shift of emphasis. Only in the physical sciences has it maintained its traditions of achievement. With what it has accomplished since 1885, a date that marks approximately the beginning of a new era in the scholarship of America, I shall not deal. Instead, I shall carry you back to the days when it was still a pioneer, a source of inspiration to the men who laid the foundations of the physical sciences in the universities of the United States. Of the physicists, who have first claim to attention, I can mention only two—De Volson Wood ('57) and Henry Augustus Rowland ('70). In Michigan, Wood instituted the policy of separating the pure and applied sciences which has been adopted by most, or all, of the state universities. At Rensselaer, and later at Johns Hopkins, where he became first professor of his subject, Rowland conducted the researches which gave such a striking impetus to the development of physics during the last fifty years. In the old main building which stood not far from the head of the Approach, he completed his investigations of the maximum magnetization of iron, nickel and steel; and there, too, he formulated the principles governing his classic researches on the magnetic effect of electrostatic charges in motion. To those of us who are entrusted with the advancement of knowledge, it is a sobering reflection that the results of these studies can be compassed by the narrow span of a single generation; for there are not a few here to-day who remember as students the little corner room which Rowland abandoned for his famous "shop" in the city of Baltimore.

In speaking of the contribution of the institute to the development of chemistry, I can not do better than follow the plan which I have adopted in the case of physics. If I had time, I would like to describe the emphasis placed upon the subject in the curriculum. It was this emphasis which made it possible for the alumni to establish departments of chemistry in many institutions of high rank. It was this emphasis, also, which drew them—the first Americans—to the universities of Europe. With the name of one of these adventurers, Eben Norton Horsford, to whom I have previously referred, the campaign now being conducted by Harvard University has made many of you familiar; for it was Horsford, who, as

Rumford professor, induced Abbott Lawrence to establish a school devoted to analytical and practical chemistry in which he conducted the first laboratory courses of any importance given in Cambridge. Of the influence of those courses upon the fortunes of President Eliot, the Massachusetts Institute of Technology and countless other men and institutions you are all aware. The name of another, James Curtis Booth ('31), is also not unknown to some of you. Booth, the most eminent chemist of his day, who founded in Philadelphia the first commercial laboratory devoted to analysis and research, performed for the University of Pennsylvania a service not unlike that rendered by Horsford for Harvard. I might well speak, too, of other men—with no training except that which they received here—who served with no less distinction at smaller institutions such as Rutgers and Williams. Nevertheless, it is to the west that I must turn again in conclusion; for to the great universities like Michigan and Wisconsin they carried the new learning of the school founded by Stephen Van Rensselaer. In the two which I have mentioned, as well as in the universities of Alabama and California, they also led in the application of chemistry to the needs of agriculture. Moreover, in the medical departments of half a dozen universities and a dozen medical colleges, such as Rush and Pennsylvania, they were professors of chemistry in its relation to medicine and sponsors of new and revolutionary methods of analysis and diagnosis.

In geology and mineralogy, of course, Rensselaer was long supreme. From those connected with the institute came the first standard texts—the first, you may be interested to know, in which figures and plates were used to supplement the text—and from them also come the first epoch-making reports. Indeed, approximately half of all the notable developments in these two subjects before 1850 were due to graduates of the institute. They were responsible for the official surveys of Alabama, Delaware, Iowa, New Jersey, New York, North Carolina, South Carolina, Michigan and Wisconsin. In other states their advice and assistance were hardly less useful. Moreover, in a number of colleges and endowed universities as well as in the state universities of Alabama, Iowa, Michigan and Wisconsin, they established a tradition of research which has been honorably maintained by their successors. Among them were many who deserve to be remembered; and yet I must hurry on with a passing reference to two who have special claim to consideration—Ebenezer Emmons ('26), junior professor at the institute and discoverer of the Taconic System, and James Hall ('32), professor of geology and "father of American stratigraphy."

If time served, I would like to speak of other subjects such as astronomy—long stressed at Rensselaer—in which it was able to aid the universities, like Cornell, which were founded after it. In mathematics, also, handmaid of both science and engineering, its graduates were pathfinders at half a dozen institutions. Of necessity, however, I must turn to engineering, a field in which the institute was a pioneer and in which it was long without a rival. In the beginning, however, it did not offer a distinct course in engineering. Not until 1835, as President Ricketts has indicated, was the first class graduated with the degree of civil engineer. Of more immediate result from an educational point of view was the reorganization of 1850 effected by Benjamin Franklin Greene ('42), who became director in 1847. His report is the most significant event in the history of engineering education. It is doubtful whether any other document of similar character has exerted such a profound and far-reaching influence. Aside from local variations in content and method, the scheme formulated by Greene has remained the norm throughout the United States. It is no exaggeration, therefore, to say that by 1850 the essential features of every technical school had appeared at Rensselaer. Nor is it an exaggeration to say that, during the next thirty years, it impressed them, through its alumni or its curricula, upon every institution dedicated to similar aims.

Lafayette and Swarthmore, Cornell and Princeton, Michigan and Minnesota—such are the types—colleges, endowed universities and state institutions—in which the graduates laid the foundations of the departments and colleges of engineering. Columbia and Pennsylvania, Missouri and Texas—such are the types in which they have done valiant service. Nor, above all, ought we to forget the great technical schools—of which Massachusetts and Stevens are symbolic—which drew on Rensselaer not only for some of their first and most eminent professors but also for the curricula which it had evolved. And yet I would lead you astray if I were to suggest that the influence of the institute has been limited to the states of the Union. For a century it has drawn students from other lands, and for a century they have returned to duplicate in them the departments and colleges established by their classmates in the Republic. In Canada they have left their mark on several of the provincial universities. In Mexico, in the countries of Central and South America, in China and in Japan they have also been explorers, carrying the sacred fire from the altars of this modern city with its ancient name to the temples of learning which they have helped to rear. Such is the tradition of achievement which we are met to commemorate.

Though it seems fitting that, on an occasion like

this, we should emphasize the part which the institute has played in the republic of education, we should remember that the majority of its graduates have spent their lives in the world of affairs and that there is no field of activity which they have not made their own. The mechanisms which they have invented; the structures which they have designed; the canals which they have dug; the railroads which they have constructed; the ships which they have launched; the mines which they have sunk; the ores which they have treated; the businesses which they have organized; the industries which they have directed—these, the final fruits of its endeavor, are subjects to which I can not do justice to-day. Emory, Gurley, Riddell, Thacher—figures inseparately associated with the development of exact standards of measurement and calculation! Do I need to remind you, the legatees of their success, of the services which they rendered to their generation? Murphy, Roberts—pioneers in design and manufacture, workers in iron, spanners of floods! Do I need to mention them? Boller, Buck, Cooper, Hodge, Macdonald, Roebling—a brilliant galaxy—craftsmen in steel, conquerors of chasms! Shall I remind you, the inheritors of their traditions, of the achievements which you have so faithfully emulated? Ferris, Shankland—intrepid experimenters in a new architecture! Menocal, Fuertes—explorers, linkers of seas! Evans, Kneass; Cassatt, Crocker; Roberts, Voorhees—trailbreakers and executives whose names are grooved across the continent! Babcock, Mallory; Hopkins, Morse—shapers of ships, masters of men! Pardee, Rothwell; Metcalf, Reeves; Cogswell, Wallace; Lewis, White—spoilers of earth, moulders of metal, generals of organization, conservers of humanity—with their careers I can not deal.

Thou hast sent us forth to labor,
Old Rensselaer.
We have wrought to win thy favor
Year after year.
Steel to wield and stone to shiver,
Sink the mine and span the river,
For thine honor toiling ever,
Old Rensselaer.

This is their story and this is yours—no bleak record of chill materialism but a single-minded devotion to the "common purposes of life" that men may find in them the essence of those higher purposes which are the goal of existence. Such is the ideal which Rensselaer, in every decade, has held before those to whom it has been the mother of learning; and this ideal, realized in the life of its sons, gathered here to do it homage, is not the least of the contributions which it has made to the civilization of America.

RAY PALMER BAKER

TRENDS IN MODERN GEOGRAPHY

GEOGRAPHY formerly was held to be the science which treats of the earth and its people. Considered in this broad sense the field included the subject-matter of many associated sciences, but with little or no correlation. The subject dealt with an infinitude of details; it was scarcely more than a scrap bag into which went a mass of unrelated material. Its methods were almost wholly descriptive; it lacked a unifying principle. Under these conditions it is no wonder that many people conceived the idea that geography was made up of the remains of various subjects and that little interest was manifested in it by the children who were burdened with a mass of facts and with the laborious, thought-deadening reproduction of maps from books.

A significant change has taken place in the scope and content of the subject of geography during the last two decades. For some years before the outbreak of the World War lecturers frequently spoke of the "new geography." The leaders of geographical thought recognized the shortcomings of descriptive geography, of fact geography and of place geography. Emphases were shifting to relational and interpretative geography. Its scope was becoming restricted and concentrated. The subject was defined as dealing with *the influence* of earth features and earth resources on the distribution, character and activities of life—plant, animal and human. This new delineation of the field emphasized the relation of earth features and earth resources to life. However, geographic topics were organized according to a standard outline: (1) Location, (2) area, (3) topography and soils, (4) climate, (5) life forms and (6) human activities. Each section, in most cases, was treated as a unit in itself, and as a result human relationships in the earlier chapters were few. No central theme pervaded these so-called geographic discussions. Moreover, in proceeding from the environment to life responses, geographers frequently assigned to environmental factors a determinant or controlling influence which they do not exert. The whole procedure was characterized by the synthetic rather than the analytic method. Furthermore, this definition called for the relation of the environment to all life, including in the field the subjects of plant and animal ecology. These fields are being developed or cultivated not by geographers but by biologists and zoologists, to whom they rightfully belong. The recognition of this situation and the insistent demands that geography be humanized have led to a clearer statement of the scope and content of the subject.

Geographers in increasing numbers define their subject as dealing solely with the mutual relations between man and his natural environment, physical

and biological. Thus defined, *geography is the science of human ecology.* According to this view, geography is not concerned with the origin and development of land forms, but with the *adjustment* of man to land forms as an element of the natural environment. In like manner, geography as human ecology would not necessitate an explanation of the causes of the different climates of the world, but would involve the distribution of the climatic types and their relations to man as an element of man's environment. Furthermore, geography would not deal with the relations of plants and animals to their physical environment, but with plants and animals as elements of the natural environment affecting men. It must be noted, however, that a knowledge of the principles of physiography, meteorology, climatology and plant and animal ecology are required for a successful portrayal and a clear interpretation of human activities in relation to the environmental features.

As *human ecology,* geography has an organizing concept, a unity otherwise lacking, a point of view unique among the sciences which deal with humanity and a field cultivated but little by any or all of the natural and social sciences. Thus, the subject affords a distinctive field and a controlling viewpoint by means of which its data may be organized with reference to the discovery and application of general truths or principles, the requisites of any science.

VIEWPOINTS AND METHODS OF TEACHING

In addition to evolution in the scope and content of geography, there has been distinct progress in the point of view and methods of teaching. The more significant changes involve (1) the broadening of our outlook from a local one to a world point of view, (2) the presentation of the subject according to natural units and geographic regions instead of political divisions, (3) the cultivation of the center of the field of the subject rather than the marginal portions, (4) the employment of terms better suited to express the relationship of environmental conditions to man, (5) the development of a body of geographic principles, (6) the adaptation of the subject-matter to the child's interest and needs, and (7) the recognition of the usefulness of geographic knowledge in trade and industry.

(1) In pre-war days the currents of trade that supplied our daily needs ran over the earth and the seas so smoothly that we had little interest in their sources or their courses. We experienced no empty sugar bowls, ate no war bread and felt no coal rationing and heatless days. The Great War changed this old order of things. It focused the attention of the whole nation on the war-gripped sections of Europe, on the Far East and even on the remote islands of the Pacific. Our horizon was extended from the borders of a single continent to the distant lands and seas of the earth. It encompassed the needs, struggles and aspirations of the masses of the world. Moreover, the peace deliberations following the war and political moves by various powers since have continued to focus our attention on the factors underlying international relationships and on the problems of new nations carved out of old ones almost overnight. An international viewpoint will continue with us because the United States has come to occupy a central position in the world. This view has permeated the field of geography and will continue to do so in a greater degree. The spirit of the "new geography" is to reach out to all types of people, to study them sympathetically in their natural environment for the purpose of solving their problems and interpreting their ideals and aims in international trade and politics. In addition to this spirit which permeates all grade work, an intensive study of the United States and its international relations is made during the last half of the eighth year's work in many schools.

(2) Years ago, in the study of geography, each state or larger political unit was treated in a detailed manner. Consequently, many facts common to one or more units were repeated for each, without any definite correlation. In contrast to this, the new geography is being taught by increasing numbers by *natural regions* as delineated by some exponents of the subject and by *geographic regions* as set forth by others, thus reducing the repetition of facts and bringing about a scientific organization of the materials and principles of the science. The study of the subject by geographic regions marks a distinct advance, for it is by this method that we can best evolve general truths and principles and apply them, for regional investigations involve facts and principles from all the divisions and subdivisions of systematic geography.

(3) Geography is closely related to history, economics and sociology on the one hand, and to physiography, geology and climatology on the other, yet it has a distinctive field of its own. History, economics and sociology deal with the complex aspects of human activity; physiography, geology and climatology treat of portions of the earth, while geography *is concerned with the relation of human activities to the environment.* It is a science of relationships. From this point of view, it is difficult to determine where we pass from geography into the social sciences; boundaries are indefinite zones and never lines. Therefore, the tendency in productive research is to cultivate the center of the field and to relinquish the marginal portions to the social sciences on the one hand or to natural sciences on the other.

(4) In the development of the subject of geography certain unfortunate terms, as "geographic control," geographic determinant, etc., have been employed by the lay teacher. The tendency among teachers to use language implying that geography in some way acts as a compelling force has caused critics to belittle the teaching of geography. The use of such terms should be avoided; better words express the meaning desired. Nature does not control man; she offers him a choice. Man adapts or adjusts his activities to geographic conditions or responds to the elements of the natural environment. It is wise for geographers to view man's relation to his environment from the standpoint of adjustment to environment rather than from that of environmental influence.

(5) There is a growing tendency in the teaching and in the study of geography to develop a number of clear-cut, general truths or geographic principles. Around these the facts of man's environment and his adjustments in the "new geography" are being organized. The study of geographic facts in order to discover and apply principles, the requisite of any science, offers interesting tasks and affords possibilities for pupils from the lower grades to the university. It promotes industry in the student and helps him to classify his geographic knowledge.

(6) Probably in no other line has progress in the field of the "new geography" been more significant and successful than in the adaptation of the subject to the needs and interests of the child. Home geography occupies a more important place in the school program. Through this medium the children are led to understand the principles of the relation of their local environment to their activities, and with this, as a base, they study, in a sympathetic manner, the environments and activities of distant peoples. They learn what people eat, wear and do, and why they do these things. The subject in the grades increases in difficulty from the home geography to the eighth grade. The new geography in the upper grades in contrast to the old in many cases is not a repetition of the preceding year's work, but a new, live subject appealing to the best efforts of the children.

(7) Modern geography is a new science, and many teachers and most college students know little of its content. They do not realize that the causal element now stressed so strongly has given it a content which has placed geography in the university curriculum and added greatly to its practical value. Business education is taking a new stride in America, and some of our best trained geographers are engaged in fitting men for the larger sphere of commerce. The government now recognizes as never before the value of trained geographers in this field. Map-publishing houses are employing skilled geographers. Large corporations, commission houses and banks recognize the necessity of having trained geographers on their staffs; they have established their own school in order to give adequate training to men in whose charge they wish to place their foreign branches. Skilled geographers are needed to accompany scientific exploring expeditions, and with the increasing need of tropical products the demand will grow. The student who prepares to teach university geography is taking advantage of one of the best opportunities in the entire pedagogical field, and rapid promotion is certain for him if he deserves it. And last, but not least, there is a wonderful service which all teachers of this science can render to humanity by giving our boys and girls through environmental relationships a sympathetic appreciation of why one's neighbor, near or remote, is what he is, and by training them in some of the fundamentals which will make them intelligent and valuable citizens of a great democracy.

CLARENCE F. JONES

CLARK UNIVERSITY

SCIENTIFIC EVENTS

THE AMERICAN ASSOCIATION'S COMMITTEE ON THE PLACE OF SCIENCE IN EDUCATION

THE American Association for the Advancement of Science is undertaking to carry out a study on the proper place of science subjects in general education, with special reference to American school curricula and to social objectives. This project was authorized by the association council at the third Cincinnati meeting, in December, 1923, and a special committee was authorized to take charge of this important investigation.

Purpose and Support

The committee wishes to formulate an adequately descriptive statement of the purposes and plans now in use in American education and of aims and improvements that seem worthy of serious consideration. This movement has originated from the thought that the unprecedented recent development of the sciences and the rapid introduction of scientific knowledge and scientific thinking into everyday life make it highly desirable that such a statement be formulated, to hasten the spread of a general understanding of the functions of science in modern education. The committee is charged with the responsibility of investigating this whole question and reporting on it at an early time. While the results of this study may not be as definite and as thoroughly based on scientific records, observation and experimentation as would be

ideally desirable, yet it is hoped that a report may be prepared, based on the constructive thought of many competent persons, that may prove very valuable, possibly forming a conspicuous mile-stone in the progress of American education.

Through its director, Dr. Max Farrand, the Commonwealth Fund of New York City has granted to the American Association for the Advancement of Science a fund to aid this work, the money to be used for paying travel expenses incurred by the committee members in attendance at called meetings.

Those interested in science education and in the part that science is playing and will play in American civilization and in our national welfare will cordially welcome the inauguration of this study under the auspices of the American Association for the Advancement of Science.

Existing Reports on American Science in Secondary Schools

In the Report of the Committee of Ten of the National Education Association published in 1893, there appeared definite statements of objectives and lists of recommended science subjects. This report was highly valuable and it served its purpose for a time, but it was eventually superseded in practice and it finally became less than an adequate record of actual accomplishment.

In 1913 a committee of fifty science teachers, under the auspices of the National Bureau of Education, began work on a revision of secondary-school science studies. Its report was published in 1920 as Bulletin 26 of the United States Bureau of Education, and was widely distributed. The purposes, outlines of subjects and sequences of subjects, as presented in that report, were based upon practices then in use in the more advanced school systems. Since the report was issued the types of courses and sequences advocated have become fairly common. Nevertheless, limitation in available time of pupils, in which they may take science, and limitation in availability of teachers with desired preparation, have probably prevented many pupils from securing as much instruction in science or the kinds of instruction thought desirable. Furthermore, the failures of the content, method and organization of science courses to respond to the most pertinent needs of modern social, industrial and esthetic uses is thought to have kept some of the objectives of the report from being as widely realized as was expected.

It seems likely that the report to be prepared by the present American Association for the Advancement of Science committee may deal not only with this problem of elementary and secondary education through school curricula, but also with the problems of science teaching in American colleges, with the social and industrial aims and interpretation of scientific research and with the problem of a proper popularizing and socializing of science knowledge.

The American Association for the Advancement of Science committee requests that all who are interested will make suggestions regarding the plan to be followed in the projected investigation, purposes, means, limitations, worthwhileness, etc., and also regarding men and women who might probably make distinct contributions to the work in hand.

The Special Committee on the Place of Science in Education.

OTIS W. CALDWELL, *Chairman*
425 WEST 123RD STREET,
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THE RICE EXPEDITION TO SOUTH AMERICA

A SUMMARY of the medical activities undertaken by the department of tropical medicine of the Harvard Medical School in connection with the Hamilton Rice expedition to South America during the present year is contained in a statement by Dr. Richard P. Strong, professor of tropical medicine in the medical school, published at the university.

Dr. Strong, who arrived in America a week ago, organized the medical activities of the expedition, having special reference to the investigation of the diseases which prevail in man and animals in the regions traversed. The expedition was organized and conducted by Dr. Hamilton Rice, first, for the purpose of geographical exploration, and second, for medical study and research. The principal geographical object was the study of the sources of the Orinoco River and the physical geography of the country in the vicinity. Dr. Rice is still in Brazil with Dr. George C. Shattuck, assistant professor of tropical medicine of Harvard University, continuing his investigations, and has with him also a trained staff and extensive equipment for making scientific observations.

The other medical members of the party, who returned with Dr. Strong, were, besides Dr. Shattuck, Dr. Joseph Bequaert, instructor in entomology in the department of tropical medicine at Harvard, and Ralph E. Wheeler, of Boston, a third-year Medical School student. Dr. Strong sailed last May to attend the congress of the Royal Institute of Public Health at Bordeaux, the remainder of the party leaving late in June. They brought back with them a large amount of material which will be further studied in the laboratories of the department of tropical medicine at Harvard University. When the study of this material has been completed a scientific report of the results will be published.

The following statement concerning the work is made by Dr. Strong:

The medical studies and investigations which have been carried out on the expedition relate particularly to that portion of the Amazon Valley extending along each side of and parallel to the equator from near the mouth of the Amazon on the east, to the River Branco on the west, a region obviously comprising the greater portion of the most tropical parts of Brazil, and constituting a strip of territory comprised between about 3° 8′ south (Manáos), and approximately 2° 5′ north latitude (Caracaray), and 50° 50′ (Pará) to approximately 64° (Parahiba) longitude west of Greenwich. It is a large plain which with the exception of those portions upon which the cities of Pará and Manáos are located, is almost completely covered with forest, and a great portion of it is semi-inundated. The climate, therefore, as one might expect, is characterized particularly by great heat and moisture, and there are an extraordinarily large number of biting insects many of which transmit disease. The great humidity and continuous high temperature throughout the year render the climate especially debilitating and enervating to those who reside in it, and the population in large areas has been at different times decimated by the infectious diseases which have prevailed.

The prevailing diseases in these regions at the present time are malaria, tropical splenomegaly, chronic ulcerative processes of the skin, leprosy and syphilis. Hookworm disease is also very common, and beriberi, dysentery, typhoid and smallpox are not infrequently seen. Special studies were conducted with respect to the cause and nature of the chronic ulcerative processes of the skin, to the tropical splenomegaly which is so very prevalent, and to the biting insects which prevail, as well as to the infections which occur in the mammals of the forest, some of whom serve as the intermediate hosts of the parasites which cause either human disease or disease in domestic animals. In connection with these studies several species of biting insects, which are probably new, and several animal parasites which have probably been hitherto undescribed, were encountered. Incidentally a number of observations were made on insects injurious to economic plants. In addition a large amount of valuable pathological material for study and for teaching purposes has been obtained.

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGIC EXCURSION

THE twentieth annual New England Intercollegiate Geologic Excursion was held in the vicinity of Providence, October 10 and 11. Professor Charles W. Brown, of Brown University, organized the excursion. Dr. Marion D. Weston led one group, Friday afternoon, to McCormick's quarry where fossil ferns and calamites occur in the Seekonk sandstones and conglomerates. A separate excursion was led by Dr. Bradford Willard, the same afternoon, to Lime Rock, a locality famous for its contact metamorphic minerals.

Saturday morning under the guidance of Professor Brown the unconformity between the basal carboniferous and the Milford granite at Neutaconkanut hill, southwest of Providence, was first visited and later a graphite mine at Rocky hill just east of the first locality. The party then motored south to the Sockanossett Mine, where Rhode Island coal is taken out to be sold at $14.00 a ton.

Professor R. M. Brown, of the Rhode Island College of Education, became guide of the party at this point and Gaspee point on Narragansett bay was visited. A study was made of the cuspate bar and folded clays near a submerged cedar swamp excited considerable discussion.

After lunch Professor C. W. Brown again assumed the leadership and an ancient Indian soapstone quarry at Ochee spring was studied. Later the intrusive contact of the Milford granite and the Precambrian quartzites and schists of the Marlboro and Westboro formations was seen at the Manton Avenue quarry. The excursion was brought to an end at the North Burial Ground where an esker of problematic relations was of interest to all.

Thirty-nine persons from ten institutions were present during the two days. The institutions represented were Brown (10), Clark (1), Colby (1), Harvard (8), Massachusetts Institute of Technology (7), Mount Holyoke (3), Rhode Island College of Education (2), United States Geological Survey (1), Wesleyan (3) and Yale (3).

WILBUR G. FOYE, *Secretary*

AWARD OF MEDALS BY THE FRANKLIN INSTITUTE

AT the stated meeting of the Franklin Institute held on October 15 the following medals were presented: The Louis Edward Levy Medal to Dr. Harvey Fletcher, of the Western Electric Company, New York City, for his paper on "Physical measurements of audition and their bearing on the theory of hearing," printed in the issue of the *Journal of The Franklin Institute* for September, 1923. This is the first award of the Levy Medal, which is awarded annually to the author of a paper of especial merit, published in the journal of the institute, preference being given to one describing the author's theoretical and experimental researches in a subject of fundamental importance.

The Edward Longstreth Medal was presented to Thomas C. McBride, of Philadelphia, for his invention of a locomotive feed water heater.

The Edward Longstreth Medal was also presented to Milton Roy Sheen, of Philadelphia, for his invention of the expansion machine for tunnel construction.

All these awards were made by the institute on recommendation of the committee on science and the arts.

SCIENTIFIC NOTES AND NEWS

A SPECIAL convocation was held at Lafayette College on October 16 in connection with the exercises to celebrate the centennial anniversary of the college and the completion of fifty years of service there by Dr. Edward Hart, professor emeritus of chemistry, when the degree of doctor of laws was conferred upon Dr. Hart and that of doctor of science upon Dr. Edgar F. Smith, formerly provost of the University of Pennsylvania.

THE Bruce medal "for distinguished service to astronomy" was presented to Dr. Arthur Stanley Eddington, Plumian professor of astronomy at Cambridge University, England, by the Astronomical Society of the Pacific on October 17. The presentation was made by President William Wallace Campbell, director of the Lick Observatory. After receiving the medal, Dr. Eddington spoke on the Einstein theory of relativity.

PALMER C. RICKETTS, director of the Rensselaer Polytechnic Institute, Troy, has been made a Commander of the Legion of Honor by France. The Italian government recently made Dr. Ricketts a Knight Commander of the Order of the Crown of Italy.

SIR WILLIAM BRAGG, Fullerian professor of chemistry in the Royal Institution, was awarded the honorary degree of D.C.L. by the University of Durham, on the occasion of the opening of the new college of pure science at the university on October 1.

PROFESSOR R. STANZIALE, of the chair of dermatology at Naples, has been made a chevalier of the Legion of Honor by the French government in tribute to his works presented at the International Congress on Leprosy at Strasbourg last year.

DR. F. G. COTTRELL, director of the fixed nitrogen research laboratory of the U. S. Department of Agriculture, has been elected to be one of the vice-presidents of the American Association for the Advancement of Science and chairman of its chemical section. He will preside at the sessions of the section at the approaching fifth Washington meeting.

COL. LAURENCE MARTIN has resigned his position as geographer of the Department of State and has been appointed chief of the division of maps in the Library of Congress.

WALTER GOEBEL, who recently returned from Germany where he has spent a year in graduate work at the University of Munich, has been appointed to the scientific staff of the Rockefeller Institute, New York City, to be engaged in chemical research.

MAJOR JAMES STEVENS SIMMONS, assistant director of laboratories, Army Medical School, Washington, has been appointed associate editor of *Abstracts of Bacteriology*.

DR. J. L. AMES has resigned as professor of medicine at the Tufts Medical School after 22 years of teaching there.

DR. RICHARD WILLSTATTER, who recently resigned his position as professor of chemistry at the University of Munich, has decided not to accept another university position but to carry on his research work privately.

DR. CARL E. CORRENS, director of the Kaiser Wilhelm Institute of Biology and professor of botany at the University of Berlin, celebrated his sixtieth birthday on September 19.

PROFESSOR HUGO V. SEELIGER, director of the Munich observatory and formerly president of the Bavarian Academy of Sciences, celebrated his seventy-fifth birthday on September 23.

DR. THORVALD MADSEN, of the Serum Institute of Denmark and a consultant of the health department of Denmark; Dr. Tryde, of the health department of Denmark; Dr. Fridericia, professor of medicine, University of Copenhagen; Dr. Andreas Diesen, head of the Bureau of Sanitation of the Health Department of Christiania, Norway, arrived in New York on October 10 as guests of the International Health Board of the Rockefeller Foundation.

FREDERICK G. CLAPP, of New York, is engaged in geological explorations in the so-called Kimberley Desert region of northwestern Western Australia.

DONALD B. MACMILLAN, the Arctic explorer, who recently returned from Northern Greenland, intends to devote his attention for some time to northern Labrador. He will probably go north next June on a three months' trip to select a site there for a station for the study of geology, botany and ornithology.

M. BRUNEAU DE LABORIE, the French explorer, who last year made a journey from Lake Chad to Egypt, is leaving Algiers in order to cross the Sahara to the Atlantic coast.

DR. WILLIAM SNOW MILLER, professor of anatomy at the University of Wisconsin, will deliver the second Harvey Society Lecture at the New York Academy of Medicine, on October 25. His subject will be "A study of the normal and pathological histology of the lung."

DR. ARCHIBALD VIVIAN HILL, professor of physiology at University College, London, delivered a lec-

ture on "The ultimate nature of the muscular machine" at the Franklin Institute on October 15.

DR. CHARLES FABRY, professor at the Sorbonne and president of the French Physical Society, will deliver a series of twelve lectures at the Massachusetts Institute of Technology on the subject of "Light interference phenomena and their applications." The lectures will be given on Tuesdays and Fridays, beginning on October 13.

DR. ERWIN F. SMITH, of the U. S. Department of Agriculture, gave an address in French, on "Cancer of plants," before the Société de Pathologie végétale et d'Entomologie agricole de France, in the amphitheater of the Museum of Comparative Anatomy, Paris, on October 3.

DR. E. F. ARMSTRONG, retiring president of the Society of Chemical Industry, addressed the regular meeting of the society on October 17 on "The fats from many aspects."

DR. C. A. SHULL, of the University of Chicago, lectured before the Purdue Biological Society at a dinner meeting on October 13, on "The future of plant research in America."

THE Harveian Oration before the Royal College of Physicians of London was delivered by Sir Archibald E. Garrod, Regius professor of medicine in the University of Oxford, on October 18.

THE life and work of Dr. G. Stanley Hall are to be commemorated at Clark University on Founder's Day, February 1 to 3. On the first day addresses will be delivered by leading alumni of the university and others whose relations with Dr. Hall were intimate. On the second there will be an address concerning Dr. Hall's work as a university president and patron of research. The third part of the commemoration will consist of a brief scientific conference upon genetic psychology.

PROFESSOR EDGAR LUCIEN LARKIN, director of the Mount Lowe Observatory and lecturer and writer on astronomy, died on October 11 at the age of seventy-seven years.

DR. ARCHIBALD MACLAREN, professor of surgery at the University of Minnesota Medical School, chief of staff at St. Luke's Hospital, St. Paul, died on October 13 at the age of sixty-six years.

DR. WILHELM ROUX, professor emeritus of anatomy, University of Halle, and a pioneer in the study of the mechanics of biology, died on September 15, aged seventy-four years.

DR. ANDRÉ BERGÉ, a well-known Paris cardiologist, has recently died at the age of sixty-one years.

THE United States Civil Service Commission has announced an examination for junior physicists to be held throughout the country on November 19. It is to fill vacancies in the Bureau of Standards, Department of Commerce, at an entrance salary of $1,860 a year. Advancement in pay may be made without change in assignment up to $2,400 a year.

A SPANISH Congress of Medical Science was held at Seville from October 15 to 20, under the presidency of Professor Recasens, of Madrid.

A SERIES of free public lectures on travel and natural history, illustrated by still and moving pictures, will be given at the Field Museum, Chicago, on Saturday afternoons at 3 o'clock during October and November. Dr. William Beebe, author and zoologist; Ernest Thompson Seton, Professor Ira M. Price, of the University of Chicago, and Dr. William Elliot Griffis are among those who will give lectures.

THE Tokyo University library, which was destroyed in the earthquake a year ago, is now being restored, a large number of books having been presented by the Rockefeller Foundation, the Universities of Rome, Germany, Michigan, Columbia and California, educational bodies connected with the French Academy and other countries, including India, Australia, Holland and Switzerland.

THE *Journal* of the American Medical Association states that the dean of the faculté de médecine of the University of Montpellier, France, has been authorized to accept, in the name of the university, the bequest of 100,000 francs made to the institution by M. J. F. L. Cabanes. This sum is to be used to establish a prize to be awarded the discoverer of a preventive or curative remedy recognized as efficacious for the treatment of tuberculosis. The interest on this sum is to be used every year for one or more prizes to encourage work in the same field.

MR. AND MRS. CHARLES S. FAIRCHILD, of Cazenovia, New York, have given to the museum of Colgate University the fossil collection of Ledyard Lincklaen, distinguished in geology and a friend of Professor James Hall.

SPECIMENS from the petrified forest national monument will be given to colleges and museums desiring them, upon payment of the expense of boxing and shipping, according to an announcement made by the National Park Service.

THE Pasteur Institute of Kindia Quinea, a branch of the Pasteur Institute in Paris, has recently been organized. Researches can now be made on the anthropoid apes of western Africa, in connection with experimental studies on the transmission and the curability of leprosy, tuberculosis and cancer.

A RESEARCH into the harboring of plague by wild rodents and the specific prophylaxis and therapy of the disease in man, is being undertaken by the South African Institute for Medical Research, Johannesburg. The work is to be carried out largely in a mobile laboratory on the veld. The present staff of the institute is to be augmented by a bacteriologist and an entomologist.

THE first elaborate attempt to preserve the native antelopes that abound in the northwest corner of South Dakota is to be carried out in an area of approximately 15 square miles near the Slim Buttes of Harding County.

AN effort to save from extinction the European buffalo, said to be the rarest living mammal in the world, has begun in Stockholm with the opening of a 100 acre preserve, where these animals will be allowed to live and breed under natural conditions. Out of a total of only fifty-six European buffaloes known to be living at the present time, seven are to be found in Sweden, and up to the present time this herd has been kept in the open air museum of Stockholm.

THE Belgian Colonial authorities are now laying off a large tract of territory in the Kiva district (the gorilla country), and this is to be a sanctuary for gorillas and for all other wild animals. Within these bounds not only the fauna but also the flora will be left undisturbed. Provision has been made for a sufficient number of wardens to prevent the intrusion of hunters and to prevent the destruction of plants or trees. The sanctuary will be a sort of Garden of Eden where the animals may live amid their natural surroundings, without fear of man. This reserve lies in the northeastern part of the Belgian Congo between Lake Kiva and Uganda. It embraces the three volcanoes of Mount Mikeno, Mount Karissimbi (altitude 13,500 feet) and Mount Visoke, comprising an area of about 250 square miles of high and healthy territory, with a variety of temperature varying from the mild climate of the plains to the colder atmosphere of the mountain heights. Here the gorilla may live in peace, and the scientists disarmed may come and study the living animal on his native heath.

FISH planting in the streams and lakes of the national parks is becoming an increasingly important item in park administration, according to the Department of the Interior. During the last year, through the cooperation of the United States Bureau of Fisheries and the Montana State Bureau of Fisheries, 18,635,200 Lock Leven and brook trout fingerlings and black-spotted trout fry and eyed eggs were planted in the lakes and rivers of Yellowstone National Park. Most of the fish-planting operations have been in charge of the Bureau of Fisheries, which maintains a hatchery at Yellowstone Lake, although the planting of nearly 100,000 fingerlings supplied by the Montana State Bureau of Fisheries was done by park rangers.

To observe scientific methods of growing timber crops as developed during the past 15 years in the historic Harvard forest at Petersham, the Northeastern Forest Research Council and a committee of the pulp and paper industry met there on September 4 and 5, according to *Chemical and Metallurgical Engineering*. The Research Council was appointed by Secretary of Agriculture Wallace last winter for the purpose of promoting forest research and of working out more reliable methods of growing timber in the forests of the northeast. The council, which is composed of representatives of all interests concerned with forest research, is acting in an advisory capacity to the Northeast Forest Experiment Station, forest schools, state forestry departments and other forest research agencies in the northeast. The meeting will be devoted primarily to studying the successful forestry operations carried out by Harvard University during about fifteen years of intensive forest management. The conference will also discuss present and proposed forest research programs in the forests of the northeast, the location of substations for the Northeastern Forest Experiment Station, and the Clarke-McNary forestry bill passed by the last session of the congress.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Mrs. Arabella D. Huntington the Hampton Normal and Agricultural Institute will receive $100,000, the American Museum of Natural History $50,000 and the American Geographical Society $25,000.

MARIETTA COLLEGE, Ohio, has received $50,000 by the will of the late Catherine A. Mather, daughter of the first president of the college.

RADCLIFFE COLLEGE, Cambridge, Mass., has received a bequest of $5,000 through the will of the late Joseph H. Clark, of Boston, the income of which "shall be devoted to the advancement and encouragement of original research in such a manner as to the college shall seem best."

A GIFT of £10,000 has been made to the London School of Medicine for Women by an old student of the school who wishes to remain anonymous.

SIR ROBERT BORDEN, former prime minister of Canada, is to be installed as chancellor of Queen's University at the fall convocation.

DR. JAMES LUKENS MCCONAUGHY, president of Knox College, Galesburg, Illinois, has been elected president of Wesleyan University, Middletown, Connecticut.

JAMES R. WITHROW, professor of chemistry at Ohio State University, has been appointed professor of chemical engineering in the university and will head the new department of chemical engineering which has just been organized.

DR. THOMAS W. TURNER has resigned as professor of botany at Howard University, Washington, D. C., and is now head of the biology department at Hampton Institute, Hampton, Va.

OTTO KOPPIUS, assistant professor of physics at Oberlin College, has accepted an appointment as associate professor at the University of Kentucky.

DR. JOHN PAUL VISSCHER, late Bruce Fellow of Johns Hopkins University and special investigator of the United States Bureau of Fisheries, has been appointed assistant professor of biology in Western Reserve University.

DR. LOUIS LEON THURSTONE has been appointed assistant professor of psychology at the University of Chicago.

DR. A. C. SHEAD, of the University of Illinois, has been appointed assistant professor of chemistry at the University of Oklahoma.

DR. ROBERT DAY WILLIAMS, professor of psychology at Pomona College, has been appointed visiting lecturer on psychology at Harvard University for the first half of the academic year.

DR. H. H. DIXON, professor of botany in the University of Dublin, has been appointed Regius professor of botany in the University of Glasgow in succession to Professor F. O. Bower, who has retired.

DR. FRANK CLARE WILKINSON, of the University of Liverpool, has been appointed to the newly created chair of dental science in the University of Melbourne, Australia.

DR. PAUL SCHRÖDER, professor of psychiatry and neurology at the University of Greifswald, has been appointed professor of psychiatry at the University of Leipzig to take the place of Professor Bumke who has resigned.

DISCUSSION AND CORRESPONDENCE

ON THE RELATIVITY MOTION OF MERCURY

IN a note published in the September fifth number of SCIENCE, Professor Poor seems to have become confused as to the meaning of the gravitational radius (1.47 km) of the sun as used in Einstein's theory of gravitation. This confusion is perhaps due to the fact that Eddington, in his treatment of the subject, takes the velocity of light as unity and is not very explicit as to the physical dimensions of the quantities which he uses. Making no restrictions as to the units employed, Einstein's theory leads to the following equations for a planetary orbit,

$$\frac{d^2u}{d\phi^2} + u = \frac{m_e}{h^2_e} + 3m_e u^2, \tag{1}$$

$$r^2 \frac{d\phi}{ds} = h_e, \tag{2}$$

whereas Newton's theory gives

$$\frac{d^2u}{d\phi^2} + u = \frac{m_n}{h_n{}^2}, \tag{3}$$

$$r^2 \frac{d\phi}{dt} = h_n, \tag{4}$$

where m_e is the constant obtained by integrating Einstein's field equations and m_n is the gravitational mass of the sun in astronomical units. Moreover ds and dt are related to a sufficiently high degree of approximation by the equation

$$ds = c\,dt$$

where c is the velocity of light.

Comparing (2) and (4) in view of this relation it is clear that

$$h_n = c\,h_e$$

Eddington shows that the second term on the right hand side of (1) is very small compared to the first. So neglecting this term comparison of (1) and (3) gives

$$m_e = \frac{h_e{}^2}{h_n{}^2} m_n = \frac{m_n}{c^2}$$

As we are making the gravitational constant unity, Newton's law has the dimensional form $LT^{-2} = m_n L^{-2}$, showing that m_n has the dimensions L^3T^{-2}. Therefore, the gravitational radius m_e is of the dimensions of a length, and does not change from 1.50 km to 13.5 $(10)^{20}$ km according to the choice of units, as Professor Poor would have it do.

LEIGH PAGE

YALE UNIVERSITY

MODIFICATIONS RELATING TO THE "NEW INTERNATIONAL ENCYCLOPAEDIA"

IN a recent number of SCIENCE, Vol. LX (1924), page 82, attention was directed to a very obvious error relating to Copernicus which appears under his name in the 1923 printing of the well and favorably known American encyclopaedia noted in the heading of this article. It should have been stated then that

this error is found also in Volume 9 of the "Biographie Universelle" (Michaud), nouvelle édition, as well as in the "International Cyclopaedia," which was the predecessor of the work under consideration. One might have thought that the biography of such an eminent scientist as Copernicus would not involve such obvious misstatements nearly four hundred years after his death. In fact, the chief interest in this error is due to its persistence notwithstanding its obviousness. It should be added that most of the modern biographical accounts of Copernicus do not involve this error.

A less obvious but more serious error appears in the work under consideration under the term "Descartes rule of signs." It is here stated that "the rule also bears Harriott's name, being given in his 'Artis Analyticae Praxis'." It has been known for a long time that this rule does not appear here and that Leibnitz was responsible for giving currency to this widespread error. In Volume 10 of the "Bibliotheca Mathematica" G. Eneström noted many places where this error may be found. A still more serious error appears under the term "Descartes," where it is stated that he "placed the theory of negative quantities on a satisfactory basis." In this connection it is perhaps sufficient to refer to the fact that in Volume 2 (1921), page 78, of Tropfke's "Geschichte der Elementar-Mathematik" it is stated that the mathematics of the eighteenth century suffered because a satisfactory introduction of negative numbers was then lacking. This was a century after the time of Descartes.

The student who consults this encyclopaedia for the purpose of securing some general knowledge as regards mathematical groups is referred under the word "groups" to the article on "substitution." This would have been a satisfactory procedure seventy years ago, but since that time the general theory of groups has been developed so extensively that the theory of substitutions forms now a relatively small part of this general theory. Hence the broader theory should have been outlined under the term group, while a reference might properly have been added with respect to more special developments under the term substitution. It may be added that in the present article under the latter term one finds the statement that it was a discovery due to Galois "that eventually led to the proof of the insolubility of the quintic." On the contrary, it is well known that this insolubility was established by Abel several years before Galois was old enough to publish new results relating to mathematics even if he began to publish such results at the early age of 17.

It is well known that the first published *formal* algebraic solution of the general cubic and the general biquadratic equations appeared in the "Ars Magna," 1545, written by an Italian mathematician and physician named Cardan. Since complex numbers were not then understood the authors of these formal solutions necessarily failed to understand their generality and could use them only in special cases. In view of these facts one reads in the present work with amazement the following statement under the term "Cardan": "The publication of the 'Ars Magna' stimulated mathematical research and hastened the general solution of biquadratic equations of which Cardan himself solved special cases, as $13x^3 = x^4 + 2x^3 + 2x + 1$; although the credit of producing the first general solution belongs to his pupil Ferrari." This solution by Ferrari is actually found in the "Ars Magna" in question.

In regard to the cubic equation one finds at the same place the following statement: "The solution had been discovered in 1541 by Tartaglia who communicated it to Cardan under the most solemn vows of secrecy." In fact, Cardan himself stated that he made this discovery in 1535, but this is a somewhat minor matter. It is much more important to note that all modern mathematical historians agree that the formal solution of the cubic had been discovered at a considerably earlier date by another Italian mathematician commonly known as Ferro. It is, of course, clear that Ferro could not have fully understood the generality of his results and that he may not have recognized that all forms of the cubic equation can be reduced to the form considered by him. Since this reduction is so very elementary and since we know very little about the work of Ferro such details will probably always remain matters of conjecture or matters of silence, if ignorance implies silence.

While one should not expect to find always in such a general work as accurate statements as are demanded in the special scientific treatises, yet it seems that in many cases a greater degree of accuracy might reasonably be expected. For instance, under the term "cubic equation" it is stated that the roots of the equation $x^3 + px + q = 0$ will all be real when p is negative and $4p^3 > 27q^2$. This inequality implies that a negative number can be greater than a positive number, since it results from the context that q is supposed to be real. Several other inaccuracies which can also be easily corrected appear under the same term and also under the term "series." Since the history of science is mainly an exposition of the compound interest law as regards the development of fundamental concepts it is very important to secure a clear notion with respect to the early development of such concepts.

Under the term "Trigonometry" it is stated that a ratio called *seqt* in the work of Ahmes "seems to correspond to the cosine or the tangent of an angle." The word "tangent" should evidently be replaced here

by cotangent. What is, however, very much more important is that we find here the statement that "Rheticus (1514–76) made a great advance by considering the functions as ratios instead of lines." This is also a very fundamental question relating to the history of elementary mathematics, and the widespread error involved in this quotation was considered by Tropfke in Volume 5, 1923, page 19, of the work noted above in the second paragraph. It is here explained that the modern conception of the trigonometric functions as abstract numbers did not appear before the second half of the eighteenth century, that is, about two hundred years after the death of Rheticus.

In closing we shall refer to one more misleading statement relating to a historical question of fundamental importance. Under the term "Analytic Geometry" it is stated that "the primitive system of coordinates called rectangular coordinates is due to Descartes (Lat. Cartesius) from which fact they are called Cartesian." On the contrary, Descartes did not have a clear notion of such coordinates and some rectangular as well as oblique coordinate systems were used in very early times, especially by the Greeks.[1] They were also used in Europe long before the time of Descartes. In particular, such a system is found in the works of Oresme in the fourteenth century. From what precedes it is clear that in some particulars the popular work under consideration is still in need of much improvement. It is hoped that this discussion may disclose some facts of interest to the general reader and may also have some influence on speeding the needed modifications, which are fortunately made feasible by the frequent printings. In fact, some important corrections resulted from a similar effort made several years ago. *Cf. American Mathematical Monthly,* Volume 24 (1917), page 106.

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THE CONTROL OF DAMPING OFF OF COTTON SEEDLINGS BY THE USE OF USPULUN

OWING to the unusually large amount of rainfall prevalent in northwest Arkansas in May and the early part of June, 1924, damping off of cotton seedlings became very prevalent, particularly in those rows where the stand was the thickest and best. As this threatened to destroy some valuable breeding work it was felt that something ought to be tried to effect control, although it was recognized that under field conditions there was very little promise of success.

Accordingly, a 0.25 per cent. solution of Uspulun was prepared, the strength recommended by the manufacturers (Bayer Chemical Company), and the solution applied in a sprinkling can to five rows of cotton. Approximately one gallon of solution was applied to the square foot of soil. Only one application was made. The results obtained are so promising that it seems worth while to present this preliminary report.

At the time of application, the soil was quite moist and the solution was taken up very readily. No particular effort was needed to force the solution into the soil, for there was but little surface drainage. The solution was applied directly over the plants with an ordinary sprinkling can, the application being made slowly so as to enable the soil to take up the solution.

No further damping off has appeared in the five treated rows. In the untreated rows damping off continued to develop to such an extent that large parts of the rows are now bare in contrast to the treated rows on which the stand is much better. A microscopic examination showed that most if not all the damping off was caused by Rhizoctonia. The treated plants have shown no ill effects from the treatment.

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NOTICE TO ZOOLOGISTS OF GENERIC NAMES TO BE INSERTED IN THE OFFICIAL LIST

THE following generic names (with genotype in parentheses) have been submitted to the International Commission on Zoological Nomenclature for inclusion in the Official List of Generic Names.

The secretary will delay final announcement of the votes on these names until January 1, 1925, in order to give to any zoologists who may desire the opportunity to express their opinions.

Mammals: *Alces* Gray, 1821, 307 (*alces*); *Arvicola* Lac., 1799, 10 (*amphibius*); *Ateles* Geoffr., 1806, 262 (*paniscus*); *Bison* H. Smith, 1827, 373 (*bison*); *Bradypus* Linn., 1758a, 34 (*tridactylus*); *Canis* Linn., 1758a, 38 (*familiaris*); *Capra* Linn., 1758a, 68 (*hircus*); *Cebus* Erxl., 1777, 44 (*capucina*); *Cervus* Linn., 1758a, 66 (*elaphus*); *Cholœpus* Ill., 1811, 108 (*didactylus*); *Condylura* Ill., 1811, 125 (*cristatus*); *Cricetus* Leske, 1779, 168 (*cricetus*); *Crocidura* Wagl., 1832, 275 (*leucodon*); *Cystophora* Nills., 1820, 382 (*cristata*); *Dasyprocta* Ill., 1811, 93 (*aguti*); *Didelphis* Linn., 1758a, 54 (*marsupialis*); *Erethizon* F. Cuv., 1822, 432 (*dorsata*); *Felis* Linn., 1758a, 41 (*catus*); *Gulo* Pallas, 1780, 25 (*gulo*); *Halichoerus* Nills., 1820, 376 (*grypus*); *Lepus* Linn., 1758a, 57 (*timidus*); *Lynx* Kerr, 1792, 32 (*lynx*); *Mus* Linn.,

[1] *Encyclopédie des Sciences Mathématiques,* tome 3, Vol. 3, p. 17.

1758a, 59 (*musculus*); *Myrmecophaga* Linn., 1758a, 35 (*tridactyla*); *Nasua* Storr, 1780, 35 (*nasua*); *Ovibos* Blainv., 1816, 76 (*moschatus*); *Phyllostomus* Lac., 1799, 16 (*hastatus*); *Procyon* Storr, 1780, 35 (*lotor*); *Putorius* Cuv., 1817, 147 (*putorius*); *Rangifer* H. Smith, 1827, 304 (*tarandus*); *Rhinolophus* Lac., 1799, 15 (*ferrum-equinum*); *Rupicapra* Blainv., 1816, 75 (*rupicapra*); *Sciurus* Linn., 1758a, 63 (*vulgaris*); *Sorex* Linn., 1758a 53 (*araneus*); *Vespertilio* Linn., 1758a 31 (*murinus*).

Amphibia: *Cryptobranchus* Leuck., 1821, 259 (*gigantea* = *alleganiensis* = *alleghaniensis*); *Desmognathus* Baird, 1849, 282 (*fuscus*); *Siren* Linn., 1766, addenda (*lacertina*).

Reptilia: *Alligator* Cuv., 1807, 25 (*mississipiensis*); *Calamaria* Boie, 1827, 236 (*calamaria*); *Chelydra* Schweigg., 1812, 292 (*serpentina*); *Crotalus* Linn., 1758a, 214 (*horridus*); *Dermochelys* Blainv., 1816, 119 (*coriacea*); *Eremias* Wieg., 1834, 9 (*velox*); *Lacerta* Linn., 1758a, 200 (*agilis*); *Mabuya* Fitz., 1826, 23 (*sloanii*); *Phrynosoma* Wieg., 1828, 367 (*orbiculare*).

Pisces: *Blennius* Linn., 1758a, 256 (*ocellaris*); *Echeneis* Linn., 1758a, 260 (*naucrates*); *Esox* Linn., 1758a, 313 (*lucius*); *Ophidion* Linn., 1758a, 259 (*barbatum*).

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SCIENTIFIC BOOKS

The Devonian Crinoids of New York. By WINIFRED GOLDRING. Published by the New York State Museum, 1924, John M. Clarke, Director. Memoir 16. One volume, 4to, 483 pp. text, 60 plates, 63 text-figures; with explanation of plates and index, total 670 pp.

THE appearance of this superb volume, long expected and long delayed, marks an epoch in American paleontology. It is based primarily upon collections made more than half a century ago under the direction of Professor James Hall by Charles Abiathar White, then a young and impecunious doctor of medicine residing in Burlington, Iowa, who in later years became state geologist of Iowa, and afterwards United States paleontologist. While conducting the first geological survey of Iowa, 1855–1858, on which White was an assistant, Hall noted his great enthusiasm and capacity for field explorations, and when that survey was concluded, took him to New York for the special purpose of collecting the Devonian fossils of that state.

The immediate result was the discovery of a colony of crinoids in the Hamilton shale of western New York near a village now called Vincent, which proved to be, as Dr. Clarke in his historical preface says, "the most extraordinary assemblage of these ancient stone lilies which the rocks of New York, or of the Devonian system, have ever afforded." A distinct crinoidal horizon was located in the Finger Lakes region, in which Dr. White continued his collection during the season of 1860 with phenomenal success, his acquisitions embracing a great number of specimens in exquisite preservation, many of which were new to science.

But little was done in the way of publication of the results of these investigations during the years which followed; but in the meantime many notable additions were made to the Devonian crinoid material from the faunas of the Portage and Chemung groups, chiefly by Dr. Clarke and under his direction. As the result of these various activities, extending over a period of upwards of fifty years, there was accumulated in the State Museum of New York at Albany an unparalleled collection of Devonian crinoids, of such magnitude and variety that nothing short of a special monograph, entirely devoted to the subject, would be adequate for its proper treatment.

The preparation of such a treatise involved a great expenditure of time and labor, for the study of the material and composition of the text, as well as for the execution of the necessary drawings. A large amount of such preparatory work was done by Dr. Clarke with a view to publication, but the pressure of official duties impeded the progress of the work to such an extent that he was at last obliged to look for assistance. To that end an arrangement was made with Dr. Edwin Kirk, then recently graduated from Columbia University, to spend a portion of his time in the study of the problems involved. His subsequent association with the United States Geological Survey, however, was followed by such increasing demands upon his time that the New York work was again subjected to protracted delays.

Finally the revision and completion of the entire theme was committed by Dr. Clarke to his associate, Winifred Goldring, who after several years of devoted study brought the work to a conclusion ready for publication. Here again another long period of delay ensued before the printing of the volume could be accomplished, so that while Dr. Clarke's historical preface to the completed work is dated in 1919, it was not until 1924 that the actual publication and distribution could be secured. Some compensation for the vexatious procrastination, however, may be found in the quality of the printing, which has been done in a manner unsurpassed by any scientific publication produced in this country. In point of typography, paper and general execution of the work, there is nothing finer in American paleontology, and the authorities

of the state of New York are entitled to the utmost credit for having provided the means for publication of a fine contribution to science in so admirable a manner.

As explained in the director's preface:

> The present book is Winifred Goldring's work. She has revised and rewritten all previous manuscripts; has compiled and checked up outstanding references; has corrected the old drawings and supervised the making of many others; has had the advantage of certain new materials which others who have touched the work did not have; and her work has been done not only conscientiously and with assiduity, but with reasonable completeness, and with credit to the paleontology of New York.

To this estimate of the value of the author's work, as evidenced by this great monograph, the present writer is glad to add his own testimonial, after a careful perusal of the volume. The many perplexing problems which arose have been handled with a maturity of judgment and depth of research that would do credit to an author of longer experience, and while producing a work that will be an honor to the state, Miss Goldring has erected an enduring monument to her own industry and zeal in the field of pure science.

The technical portion of the monograph is preceded by a popular account of the crinoids as a class, their structure, ontogeny and mode of occurrence, with special reference to those of New York, which should be most useful for the students of paleontology in the schools and institutions of the state. There are also convenient references to the literature pertinent to the subject, together with lists of the genera and species occurring in the Devonian formations, and of the localities in which they are found. The species listed, described and figured number 157, belonging to 60 genera. Of these 18 genera and 57 species are new to science, and therefore are now described and illustrated for the first time. The fine illustrations which adorn the 60 quarto plates are from the skilful brush of Mr. George Barkentin, of the State Museum staff, whose work is well known from previous publications. The figures on the plates are most usefully supplemented by the numerous text-figures interspersed throughout the descriptive matter, prepared by the author, especially the generic diagrams, which aid materially in the understanding of the new forms.

Space does not admit of extended discussion of details, in which many interesting points are brought out bearing upon structure and classification, such, for example, as the presence upon the arms of some crinoids of two or more pinnules to a single brachial, which is observed in three genera in addition to three previously known. The arrangement of the matter in the book, together with the tables and lists replete with serviceable information, and the full general index, furnish the means of convenient reference to any desired fact, which will be most welcome to paleontologists and students who have occasion to consult the work, as well as to geologists engaged in the intensive study of the stratigraphy of New York.

FRANK SPRINGER

SMITHSONIAN INSTITUTION

The Ants of Timothy Thümmel. By ARPAD FERENCZY. Jonathan Cape, Ltd., London, 1924. Price 7/6 net.

To the biologist in search of literary recreation the perusal of Professor Ferenczy's Gulliverean tale is recommended. His fantasy possesses the unusual distinction of being based on fact, to prove which an extensive bibliography, compiled with the assistance of our distinguished myrmecologist, Mr. Horace Donisthorpe, and Miss L. E. Cheesman, is appended. The story is based on the discovery of Dr. Timothy Thümmel that certain curious yellow spots on dry laurel leaves from a huge ant's nest in Central Africa represented a myrmecine attempt to bequeath to posterity the history of their race. Dr. Thümmel's "discovery" brought to its originator the inevitable result of all such discoveries: he was confined in a lunatic asylum, where he died by his own hand in 1916. And so it has been left to Professor Ferenczy to administer his literary estate—the deciphered Elm-Ant-Foot-Hieroglyphics or the Aruwimi Ant Chronicles, a brilliant travesty of human life and shortcomings. The laurel leaves were collected by Professor Ixli of Elm in the late nineties and were obtained by Thümmel through the professor's grandson. The series was unfortunately not quite complete as some of the leaves had been used by the ladies of the Elm household to add a taste to their master's favorite dish of lentil porridge!

The book opens with an account of the ant-creation. As in the Biblical story, the ant Adam and Eve (known as Mye-Mye and Nye-Nye, respectively) were created in her own image by a legendary Giant-Ant, who granted to her first subjects, among other things, the right to enter her kingdom after death, to live in her glorious presence a life of Olympic happiness "from everlasting to everlasting." Many millions of ant-generations later this tradition of the myrmecine origin was rejected as mere superstition, as the fable of our own first parents has now been assigned to the limbo of cherished beliefs. According to Mye-Mye, the road to everlasting happiness after death lay in ceaseless labor, but eons later, in the reign of the then king Tye-Kye of the Tye nation, a revolution, headed by his indolent but clever subject Kye-Kye, broke out against the ancient teaching. Kye-Kye claimed that the omnipotent Giant-Ant, whose name he said was Pye-Vye-Nye, had revealed to him that all ants must henceforth cease work and adore her

holy name under penalty of being plunged into utter darkness and in an abode of filth being turned into sheer dung beetles! Knowing, however, that a complete cessation of work must mean utter destruction, the crafty Kye-Kye, after another interview with the Ant-Mother, said that she had given him permission to represent the people, and so with a few others he formed the band of Holy Ants or Fat Bellies, which were fed and cared for by their less sacred brethren. This example was followed by the other ant-nations of the Aruwimi glade, each giving their giant-ant a particular name and laboring under the delusion that theirs was the only true Ant-Mother. As with man, so with these ants was God created in their own image. The adoption of religion, the supposed panacea of all ills, led to various holy wars which resulted in the increased power of the monarchy and their warriors. These warrior-ants desired the same life of ease as their holy brethren and formed a sect known as the Robber or Lord Ants, or more vulgarly as Big Heads. They were responsible for the despicable institution of slavery to ensure their life of luxury and ease.

Professor Ferenczy goes on to relate how the daughter of King Tye-Kye, the beautiful Tye-Nye, eloped with an ant of another nation (Hye-Hye of Hye) and of the war which resulted between the two nations. Other interesting chapters in his book (which space does not permit us to review in detail) are those dealing with the Holy Fat-Belly, Kye-Lye, who learned to write with his feet and was regarded as insane by his brothers, of the Aruwimi ants' love for the intoxicating juice of the Sacred Berry, of their marvelous systems of agriculture and weaving, of their living honey-pots, and of the betrayal of the lies of their ancestors by the Holy Kye-Pszye and the Big Head Pye-Kszye. His story reaches its climax with an account of the great Ant-World War and the eventual restoration of the laws of Mye-Mye, the great and universal truth of which reads, "The only clear title to life is Labor;" and so the ants returned to their primitive habits. Will man follow them?

Dr. Thümmel believes that the ants are at least three times as wise as us "stupid, God-forsaken, two-legged protégés of Prometheus," but his work itself belies this statement. In closing the covers of a delightful book we are compelled to agree, in two-legged arrogance, with Mr. Julian Huxley:

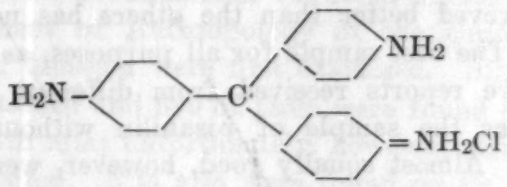
> The Ant herself can not philosophize—
> While Man does that, ...
> And flies, and talks and is extremely wise.

CEDRIC DOVER

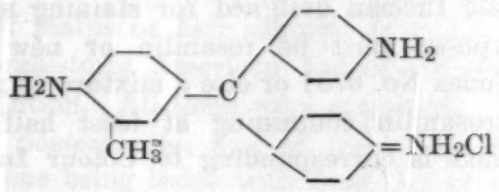
LONDON

A REPORT ON BASIC FUCHSIN

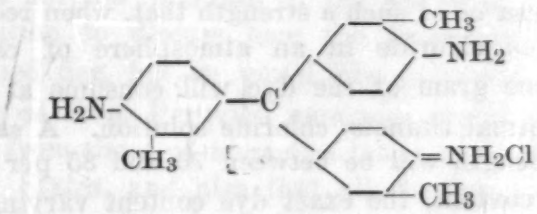
WHEN the Commission on Standardization of Biological Stains undertook the investigation of basic fuchsin, looking toward its certification, certain problems were discovered that had to be solved before definite specifications for this stain could be drawn up. There are three different compounds present to a different extent in grades of basic fuchsin. These three compounds differ from each other in the number of methyl groups they contain. The simplest of these is pararosanilin, which has the formula:



This same compound with one methyl group introduced becomes rosanilin:



With three methyl groups it becomes new fuchsin:



There are three recognized textile dyes composed of these three compounds. The first of these (which is given the number 676 in the Colour Index) is essentially pararosanilin. It is sometimes called basic fuchsin, but should probably be called basic rubin. The second (Colour Index No. 677) is a mixture of rosanilin and pararosanilin in about equal parts; it is the basic fuchsin of commerce. The third is trimethyl fuchsin, and has the Colour Index No. 678; it is known in the trade as new fuchsin. It was discovered that different stain manufacturers are supplying biologists with different compounds in this group under the name of basic fuchsin.

There are two chief purposes for which basic fuchsin is used, first for bacteriological staining (especially for the tubercle organism) and secondly for use in the Endo medium for the detection of the typhoid organism. Some manufacturers put out a special product for each of these two purposes. Others claim that theirs will do for both purposes. In the absence of authoritative information on this subject an investigation seemed to be called for.

In the course of this investigation eleven different

samples of basic fuchsin were submitted to examination. Five of them proved to be fairly pure pararosanilin, five of them new fuchsin, and the eleventh sample apparently a rosanilin almost entirely free from pararosanilin and hence different from any of the ordinary fuchsins of commerce.

The results of the investigation showed quite plainly that, although pararosanilin is ordinarily satisfactory as a bacteriological stain and for other staining purposes, it is not usually satisfactory in the Endo medium. One sample was found which gave good results when used for the latter purpose, but just why it proved better than the others has not been learned. The best sample for all purposes, as judged by the five reports received from different investigators, was the sample of rosanilin without pararosanilin. Almost equally good, however, were some of the samples of new fuchsin. Accordingly the following specifications are now drawn up to apply to basic fuchsin:

(1) Basic fuchsin designed for staining and indicator purposes must be rosanilin or new fuchsin (Colour Index No. 678) or else a mixture of rosanilin and pararosanilin containing at least half of the former (that is corresponding to Colour Index No. 677).

(2) Fuchsin samples to be certified by the commission must be of such a strength that, when reduced by titanous chloride in an atmosphere of carbon dioxide, one gram of the dye will consume at least 46.5 cc normal titanous chloride solution. A sample of this strength will be between 76 and 85 per cent. total dye content, the exact dye content varying according to the relative amounts of the higher and the lower homologs present.

(3) The sample should prove satisfactory for staining the tubercle organism and should retain its color sufficiently when treated by the Ziehl method to be diagnostic when staining tubercular discharges. This must be determined by an investigator skilled in this particular technic.

(4) The sample must prove satisfactory for use in the Endo medium. In making this test the following technic should be used: A saturated alcoholic solution is diluted 10 to 30 times, the dilution to be such that no precipitation occurs when mixed with a sodium sulphite solution. Then add 0.5 cc of this dilute fuchsin solution to 10 cc of a 2.5 per cent. sodium sulphite solution. Add it to the other ingredients of Endo agar, sterilize and cool. It should then be colorless, but the color must be restored by the colon and dysentery organisms when inoculated upon it. The test must be made by one familiar with the technic in question.

(5) It must be understood that as basic fuchsin is used in other special forms of technic, new standards may be called for. The present specifications apply particularly to the above mentioned two uses; but samples fulfilling them are ordinarily satisfactory for all histological purposes.

At the present time permission to use the commission's label on batches of basic fuchsin submitted has been given to three companies. Some of the batches submitted are recommended as satisfactory for general staining purposes and for use in the Endo medium. Others have been approved for one or the other of these two purposes only. The three companies in question are the Empire Biochemical Company, the Hartman-Leddon Company, and the National Aniline and Chemical Company. The certified samples of fuchsin do not have to be bought from these three concerns directly, but can be obtained through dealers in biological supplies. It is recommended that any one desiring fuchsin of this quality order it from some dealer, specifying the basic fuchsin certified by the Commission for either one or both of the above-mentioned purposes, according to the needs of the particular purchaser.

H. J. CONN,
Chairman, Commission on Standardization of Biological Stains
GENEVA, N. Y.

SPECIAL ARTICLES

SERIES IN THE SPECTRA OF ALUMINUM AND MAGNESIUM IN THE EXTREME ULTRA-VIOLET

PASCHEN (Ann. d. Phy., 71, p. 152, 1923) in his investigation of the spectrum of doubly ionized aluminum (Al. III) and Fowler (Series in Line Spectra, p. 120) in his study of ionized magnesium (Mg. II) have pointed out the type of series relations which exist in these substances, and have arranged many lines to conform to them. In a study of the spectra of both aluminum and magnesium in the extreme ultra-violet under various forms of excitation, I have recently observed certain lines which appear to be higher members of some of the series discovered by Paschen and by Fowler; Millikan has already identified the two strongest but the remainder seem to have escaped observation. The wave lengths and the series to which these lines belong are given in the following tables.

The lines in aluminum were obtained with the vacuum spark and also with a condenser discharge in an atmosphere of helium at about a millimeter pressure. The magnesium lines were most strongly excited by an arc of 40 volts and about ten amperes operated in a high vacuum by means of a trembler device.

The numerical values of the wave lengths should be correct to at least two tenths of a unit.

Al. III

3p.—md. Obs. λ	Int.	Calc. λ	m	3p.—ms. Obs. λ	Int.	Calc. λ	m	3s.—mp. Obs. λ	Int.	Calc. λ	m
										695.8	
891.9	(1)	892.0	4	855.0	(3)	855.02	5				4
893.8	(2)	893.9		856.7	(4)	856.76		696.0	(6)	696.2	
				725.7	(1)	725.6				560.3	
							6				5
				726.7	(2)	726.8		560.3	(3)	560.4	
								511.1	(1)	511.2	6

Mg. II

$1\sigma - m\pi$

Obs. λ	Int.	Calc. λ	m
1240.1	(4)	1239.9	
			2
1240.5	(4)	1240.4	
		1026.0	
			3
1025.9	(2)	1026.1	
946.6	(1)	946.7	4

It must be admitted that both Millikan and Simeon list a line at λ 560.5 which they credit to carbon. The line at 1025.9 in magnesium might perhaps be ascribed to hydrogen were it not for the extreme weakness of the hydrogen line at λ 1216.

The persistence of impurities, especially when high voltage excitation is employed, introduces uncertainties which can not well be eradicated. But in my judgment, the structure of the spectrum and the close agreement between observed and calculated values justifies the identification shown in the tables.

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LICE FROM HUMAN MUMMIES

FOR a very long period of time there has been discussion as to whether or not each of the different primary races of mankind harbored a distinct race of lice, particularly head lice. Confusion has followed controversy in this matter until to-day we find that there is no semblance of accord in regard to the problem. If one studies a large series of lice from living Americans it is observed that apparently there is no correlation between louse types represented and the racial types of the host individuals. It was while studying such a series that the writer became convinced that he was dealing largely with hybrids of different racial types or varieties of lice. This conviction deepened greatly when it was learned from the results of Bacot's work during the world war that the head louse of man would hybridize with the body louse and give fertile progeny.

Knowing that these two louse varieties hybridize and that there has long been an intermingling of three of the primary races of men in this continent, the writer conceived the idea of going back to prehistoric man, before the mixing of these races took place, and examining scalps of mummies in order to get samples of unhybridized lice.

Scalps of precolumbian Peruvian mummies in the Department of Anthropology of the United States National Museum were first examined. Six of these were obtained and five of them were found to be well laden with nits; unfortunately, however, no adult lice were secured. Nits also were found on an Egyptian mummy, but of the fourth century A. D. Later, through the courtesy of Dr. Frank E. Lutz, of the American Museum of Natural History, a loan was secured of scalps or hair samples from no less than twenty prehistoric American Indian mummies from that institution. All these were examined. Ten were found to possess nits; and of these ten, three also had lice, one being laden with dead lice of all stages of development.

It is not the intention of the writer of this communication to discuss here the taxonomy of these mummied lice, but he would like to record the fact that those from Peruvian mummies are slightly different from those of mummies taken in southwestern United States, and also that all the lice from prehistoric mummies show differences from some lice obtained from a living Indian. It is of course probable that our living Indians in some instances not only have the Caucasian head louse but also the Ethiopian type and possibly hybrids between these two or between the American type or types and either the Caucasian or Ethiopian type.

The American mummy type of head louse is quite distinct from what Fahrenholz describes as *Pediculus humanus marginatus,* a Japanese variety. It is much nearer what he describes as *Pediculus humanus chinensis,* the Chinese head louse. It should be stated, however, that the writer has never seen either the Japanese or Chinese type of head louse and also that he is inclined to doubt the advisability of recognizing more than one variety of louse for the yellow race of mankind.

A comparison of these mummy lice with *Pediculus* lice from American monkeys of the genus *Ateles* has been made. It should here be recalled that by many authorities the Pediculid lice of our American monkeys are considered as being only the common head louse of man. In the writer's investigation it was